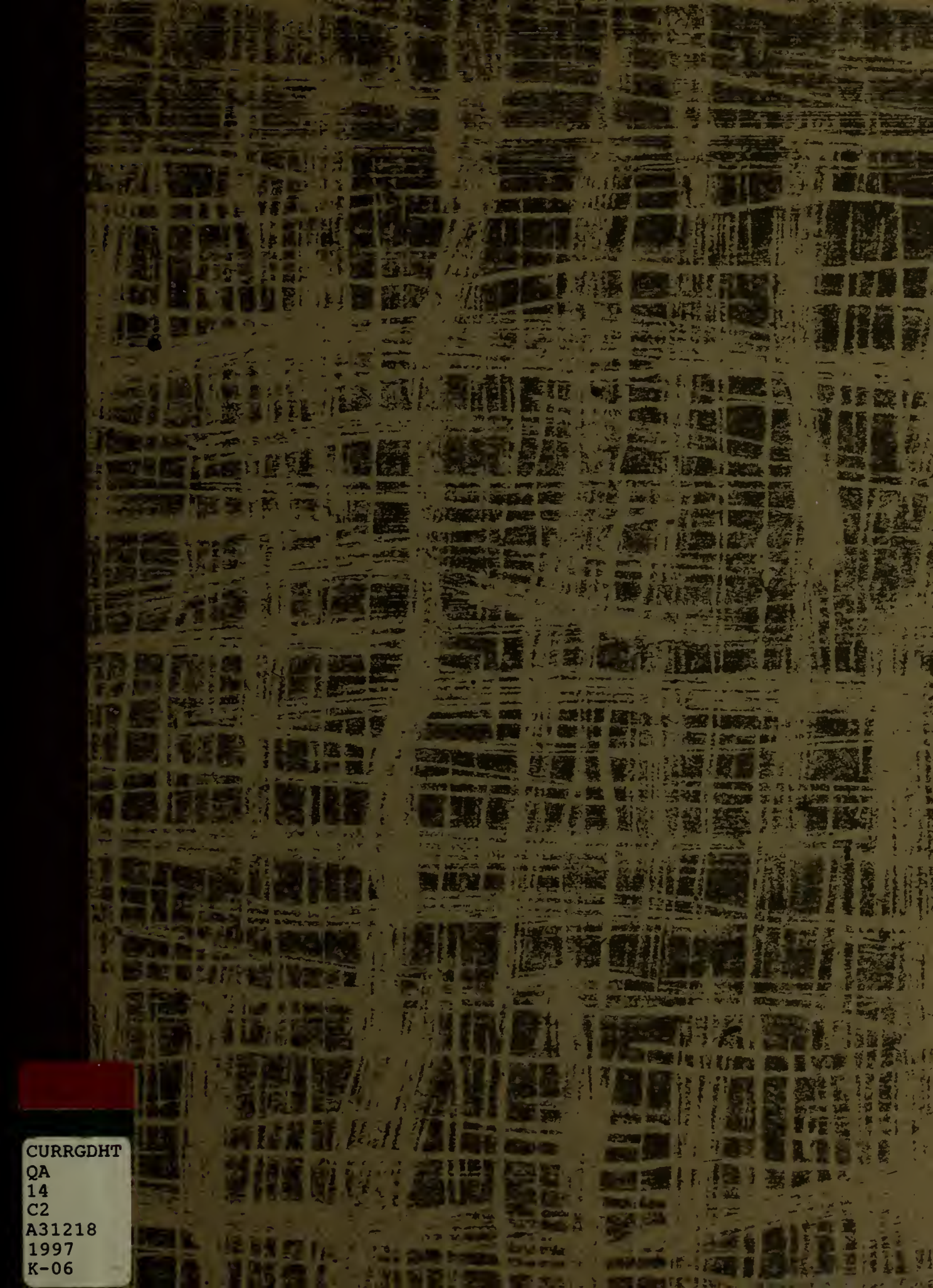

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# MATHEMATICS KINDERGARTEN TO GRADE 6

## INTRODUCTION

The Kindergarten to Grade 6 mathematics program of studies has been derived from *The Common Curriculum Framework for K–12 Mathematics: Western Canadian Protocol for Collaboration in Basic Education*, 1995 (the Common Curriculum Framework). The program of studies incorporates the conceptual framework for Kindergarten to Grade 12 mathematics and the general outcomes and specific outcomes that were established in the Common Curriculum Framework. The Kindergarten to Grade 6 mathematics program was implemented in September 1997.

## BACKGROUND

The Common Curriculum Framework was developed as a part of the Western Canadian Protocol for Collaboration in Basic Education Kindergarten to Grade 12, which was signed by the ministers of education from Alberta, British Columbia, Manitoba, Saskatchewan, Northwest Territories and the Yukon Territory.

The Common Curriculum Framework was developed to provide a common base for the curriculum expectations mandated by each province and territory. This common base will result in consistent student outcomes in mathematics across jurisdictions and will enable easier transfer for students moving from one jurisdiction to another. The intent of the Common Curriculum Framework was to **communicate clearly high expectations for students in mathematics education to all educational partners across the jurisdictions** and facilitate the development of common learning resources.

## BELIEFS ABOUT STUDENTS AND MATHEMATICS LEARNING

Students are curious, active learners who have individual interests, abilities and needs. They come to classrooms with different knowledge, life experiences and backgrounds that generate a range of attitudes about mathematics and life.

Students learn by attaching meaning to what they do; and they must be able to construct their own meaning of mathematics. This meaning is best developed when learners encounter mathematical experiences that proceed from the simple to the complex and from the concrete to the abstract. The use of manipulatives can address the diversity of learning styles and developmental stages of students and can enhance the formation of sound, transferable, mathematical concepts. At all levels, students benefit from working with appropriate materials, tools and contexts when constructing personal meaning about new mathematical ideas. The learning environment should value and respect each student's way of thinking, so that the learner feels comfortable in taking intellectual risks, asking questions and posing conjectures.

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Mathematics is a common human activity, increasing in importance in a rapidly advancing, technological society. A greater proficiency in using mathematics increases the opportunities available to individuals. Students need to become mathematically literate in order to explore problem-solving situations, accommodate changing conditions, and actively create new knowledge in striving for self-fulfillment.

## GOALS FOR STUDENTS

The main goals of mathematics education are to prepare students to:

- use mathematics confidently to solve problems
- communicate and reason mathematically
- appreciate and value mathematics
- commit themselves to lifelong learning
- become mathematically literate adults, using mathematics to contribute to society.

At the completion of a program, students should have developed a positive attitude toward mathematics and have a base of knowledge and skills related to Number, Patterns and Relations, Shape and Space, and Statistics and Probability.

It is important for students to develop a positive attitude toward mathematics so that they can become confident in their ability to undertake the problems of a changing world, thereby experiencing the power and usefulness of mathematics. Students also should gain an understanding and appreciation of the contributions of mathematics, as a science and as an art, to civilization and to culture.

Students should:

- exhibit a positive attitude toward mathematics
- engage and persevere in mathematical tasks and projects
- contribute to mathematical discussions
- take risks in performing mathematical tasks
- exhibit curiosity
- show some enjoyment of mathematical experiences.

All students should receive a level of mathematics education appropriate to their needs and abilities.



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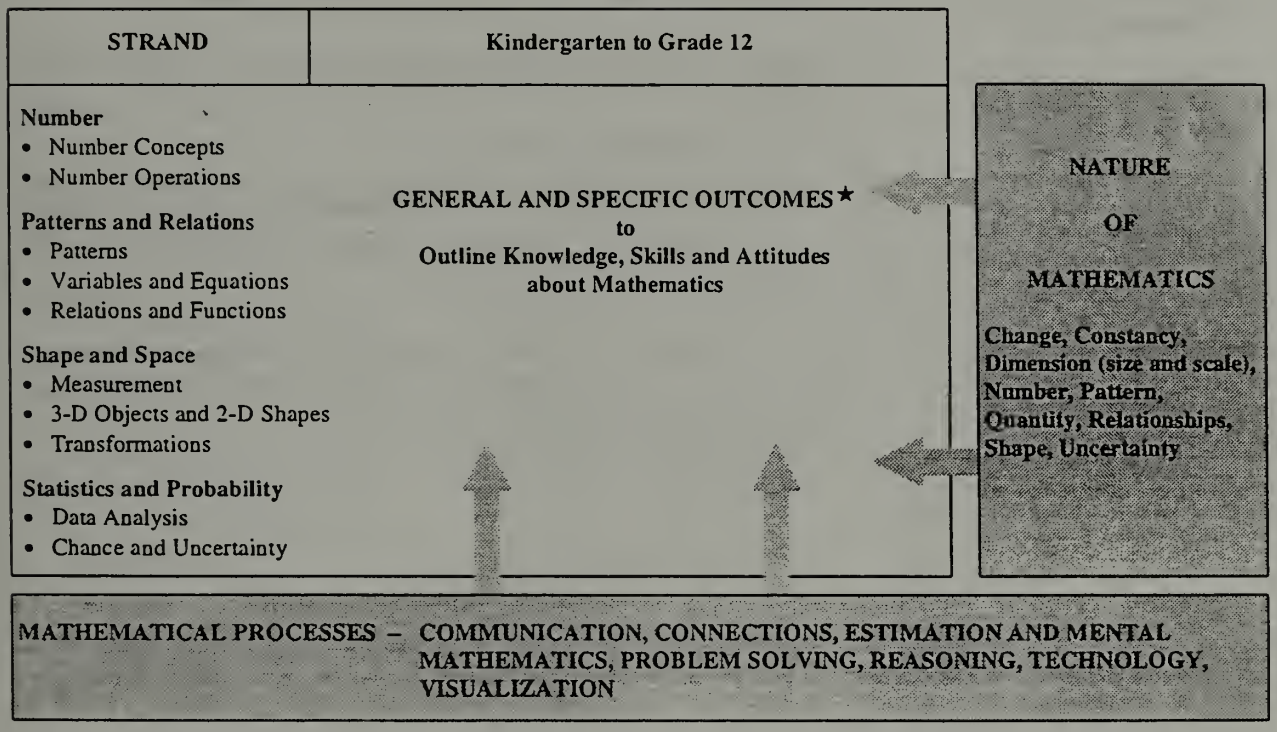
## CONCEPTUAL FRAMEWORK FOR K–12 MATHEMATICS

Students of mathematics, regardless of age or experience, struggle to do mathematics in settings that are new to them. The conceptual framework outlined in this section presents a multifaceted view of mathematics and presents the discipline as skills, procedures and concepts woven together.

The framework chart below shows how student outcomes, organized by strand, and within a grade, are designed to be influenced by Mathematical Processes and the Nature of Mathematics. These components are described more fully in this section.


STRAND
Kindergarten to Grade 12
Number
• Number Concepts
• Number Operations
Patterns and Relations
• Patterns
• Variables and Equations
• Relations and Functions
Shape and Space
• Measurement
• 3-D Objects and 2-D Shapes
• Transformations
Statistics and Probability
• Data Analysis
• Chance and Uncertainty
GENERAL AND SPECIFIC OUTCOMES★
to
Outline Knowledge, Skills and Attitudes about Mathematics
NATURE OF MATHEMATICS
Change, Constancy, Dimension (size and scale), Number, Pattern, Quantity, Relationships, Shape, Uncertainty
MATHEMATICAL PROCESSES – COMMUNICATION, CONNECTIONS, ESTIMATION AND MENTAL MATHEMATICS, PROBLEM SOLVING, REASONING, TECHNOLOGY, VISUALIZATION

★ Illustrative examples for the prescribed program of studies outcomes are provided in the companion document *Alberta Program of Studies for K–9 Mathematics: Western Canadian Protocol for Collaboration in Basic Education*, released in June 1996.



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## MATHEMATICAL PROCESSES

There are critical components that students must encounter in a mathematics program in order to achieve the goals of mathematics education and to encourage lifelong learning in mathematics. Students are expected to:

| | |
|---|---|
| *Communication* [C] | • communicate mathematically |
| *Connections* [CN] | • connect mathematical ideas to other concepts in mathematics, to everyday experiences and to other disciplines |
| *Estimation and Mental Mathematics* [E] | • use estimation and mental mathematics where appropriate |
| *Problem Solving* [PS] | • relate and apply new mathematical knowledge through problem solving |
| *Reasoning* [R] | • reason and justify their thinking |
| *Technology* [T] | • select and use appropriate technologies as tools to solve problems |
| *Visualization* [V] | • use visualization to assist in processing information, making connections and solving problems. |

The Kindergarten to Grade 6 mathematics program of studies incorporates these seven interrelated mathematical processes that are intended to permeate teaching and learning.



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## Communication

Students need to communicate mathematical ideas clearly and effectively, orally and in writing.

Communication will help students make connections among different representations of mathematical ideas; namely, "physical, pictorial, graphic, symbolic, verbal and mental representations." (NCTM, p. 26)

It is not enough to arrive at an answer. Students must be able to communicate effectively how the answer was obtained. In other words, students need opportunities to read, to explore, to investigate, to write, to listen to, to discuss and to explain ideas in their own language of mathematics. Thus, students can create their own links "between their informal, intuitive notions and the abstract language and symbolism of mathematics." (NCTM, p. 26)

### NCTM COMMUNICATION STANDARDS

| K–4 | 5–8 | 9–12 |
|---|---|---|
| *The study of mathematics should include numerous opportunities for communication so that students can:* | *The study of mathematics should include opportunities to communicate so that students can:* | *The mathematics curriculum should include the continued development of language and symbolism to communicate mathematical ideas so that all students can:* |
| • relate physical materials, pictures, and diagrams to mathematical ideas<br>• reflect on and clarify their thinking about mathematical ideas and situations<br>• relate their everyday language to mathematical language and symbols<br>• realize that representing, discussing, reading, writing, and listening to mathematics are a vital part of learning and using mathematics. | • model situations using oral, written, concrete, pictorial, graphical, and algebraic methods<br>• reflect on and clarify their own thinking about mathematical ideas and situations<br>• develop common understandings of mathematical ideas, including the role of definitions<br>• use the skills of reading, listening, and viewing to interpret and evaluate mathematical ideas<br>• discuss mathematical ideas and make conjectures and convincing arguments<br>• appreciate the value of mathematical notation and its role in the development of mathematical ideas. | • reflect upon and clarify their thinking about mathematical ideas and relationships<br>• formulate mathematical definitions and express generalizations discovered through investigations<br>• express mathematical ideas orally and in writing<br>• read written presentations of mathematics with understanding<br>• ask clarifying and extending questions related to mathematics they have read or heard about<br>• appreciate the economy, power, and elegance of mathematical notation and its role in the development of mathematical ideas. |
| (NCTM, p. 26) | (NCTM, p. 78) | (NCTM, p. 140) |



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## Connections

Students need numerous and varied experiences in order to appreciate the usefulness of mathematics and, at the same time, to explore connections within mathematics, from mathematics to other disciplines, and from mathematics to their daily experiences. When mathematical ideas are connected to each other through concrete, pictorial and symbolic representations, students begin to view mathematics as an integrated whole.

This integration "allows students to see how one mathematical idea can help them understand others, and it illustrates the subject's usefulness in solving problems, describing and modeling real-world phenomena, and communicating complex thoughts and information in a concise and precise manner." (NCTM, p. 94)

### NCTM CONNECTIONS STANDARDS

| K–4 | 5–8 | 9–12 |
|---|---|---|
| *The study of mathematics should include opportunities to make connections so that students can:* | *The mathematics curriculum should include the investigation of mathematical connections so that students can:* | *The mathematics curriculum should include investigation of the connections and interplay among various mathematical topics and their applications so that all students can:* |
| • link conceptual and procedural knowledge<br>• relate various representations of concepts or procedures to one another<br>• recognize relationships among different topics in mathematics<br>• use mathematics in other curriculum areas<br>• use mathematics in their daily lives. | • see mathematics as an integrated whole<br>• explore problems and describe results using graphical, numerical, physical, algebraic, and verbal mathematical models or representations<br>• use a mathematical idea to further their understanding of other mathematical ideas<br>• apply mathematical thinking and modeling to solve problems that arise in other disciplines, such as art, music, psychology, science, and business<br>• value the role of mathematics in our culture and society. | • recognize equivalent representations of the same concept<br>• relate procedures in one representation to procedures in an equivalent representation<br>• use and value the connections among mathematical topics<br>• use and value the connections between mathematics and other disciplines. |
| (NCTM, p. 32) | (NCTM, p. 84) | (NCTM, p. 146) |

## Estimation and Mental Mathematics

Students need to know when and how to estimate. The context of a problem helps to determine when it is necessary or desirable to have an exact answer or an estimate of that answer. Problem contexts include number, patterns and relations, shape and space, and statistics and probability. The use of technology increases the emphasis on estimation skills to enable students to determine the reasonableness of computed answers.

A variety of estimation strategies assists students in arriving at quick approximations for exact answers.

Facility with mental mathematics is an important outcome for students. A focus on mental mathematics forces students to think and improve their efficiency and accuracy in calculating, including pencil and paper calculations. Mental mathematics is the cornerstone for estimation and leads to better understanding of number concepts and number operations. (Hope, pp. 161–173)



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## Problem Solving

"*Problem solving—which includes the ways in which problems are represented, the meanings of the language of mathematics, and the ways in which one conjectures and reasons—must be central to schooling so that students can explore, create, accommodate to changed conditions, and actively create new knowledge over the course of their lives.*" (NCTM, p. 4)

Problem solving is the focus of mathematics at all grade levels. The development of each student's ability to solve problems is essential. Students develop a true understanding of mathematical concepts and procedures when they solve problems in meaningful contexts. Problem solving is to be employed throughout all of mathematics and should be embedded throughout all of the strands.

Problem solving provides an opportunity for students to be active in constructing mathematical meaning, to learn problem-solving strategies, to practise a variety of concepts and skills in a meaningful context, and to communicate mathematical ideas. Most problem-solving situations in the elementary years come from the everyday experiences of students. Students are able to attach mathematical meaning to familiar activities. As they progress through school, the problems become more complex. The problems will arise from an exploration of mathematics itself, as well as from the world around them. Gradually, students become more confident in their ability to use and communicate mathematics, using correct terminology.

As students develop mathematically, they are able to solve more challenging problems on an increasing variety of topics. Students need the opportunity "to solve problems that require them to work cooperatively (and individually), to use technology, to address relevant and interesting mathematical ideas, and to experience the power and usefulness of mathematics." (NCTM, pp. 75–76) By the time students reach the secondary level, many problem-solving strategies should be internalized and problem solving should be a process for constructing and reinforcing mathematical concepts.

Students should be confident and flexible problem solvers, using a wide range of strategies in their work, and accept that some problems have different solutions.

### NCTM PROBLEM-SOLVING STANDARDS

| K–4 | 5–8 | 9–12 |
|---|---|---|
| *The study of mathematics should emphasize problem solving so that students can:* | *The mathematics curriculum should include numerous and varied experiences with problem solving as a method of inquiry and application so that students can:* | *The mathematics curriculum should include the refinement and extension of methods of mathematical problem solving so that all students can:* |
| • use problem-solving approaches to investigate and understand mathematical content<br>• formulate problems from everyday and mathematical situations<br>• develop and apply strategies to solve a wide variety of problems<br>• verify and interpret results with respect to the original problem<br>• acquire confidence in using mathematics meaningfully. | • use problem-solving approaches to investigate and understand mathematical content<br>• formulate problems from situations within and outside mathematics<br>• develop and apply a variety of strategies to solve problems, with emphasis on multistep and nonroutine problems<br>• verify and interpret results with respect to the original problem situation<br>• generalize solutions and strategies to new problem situations<br>• acquire confidence in using mathematics meaningfully. | • use, with increasing confidence, problem-solving approaches to investigate and understand mathematical content<br>• apply integrated mathematical problem-solving strategies to solve problems from within and outside mathematics<br>• recognize and formulate problems from situations within and outside mathematics<br>• apply the process of mathematical modeling to real-world problem situations. |
| (NCTM, p. 23) | (NCTM, p. 75) | (NCTM, p. 137) |



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## Reasoning

Students need to develop confidence in their ability to reason and to justify their thinking within and outside of mathematics. The power of reasoning helps students to make sense of mathematics, to be logical in their thinking, and to convince others.

Inductive reasoning helps students explore and make conjectures from activities that allow generalizations from a pattern of observations.

Deductive reasoning helps students test conjectures and build arguments that serve to validate thinking. Deductive reasoning builds a structured body of knowledge.

### NCTM REASONING STANDARDS

| K–4 | 5–8 | 9–12 |
|---|---|---|
| *The study of mathematics should emphasize reasoning so that students can:* | *Reasoning shall permeate the mathematics curriculum so that students can:* | *The mathematics curriculum should include numerous and varied experiences that reinforce and extend logical reasoning skills so that all students can:* |
| • draw logical conclusions about mathematics<br>• use models, known facts, properties, and relationships to explain their thinking<br>• justify their answers and solution processes<br>• use patterns and relationships to analyze mathematical situations<br>• believe that mathematics makes sense. | • recognize and apply deductive and inductive reasoning<br>• understand and apply reasoning processes, with special attention to spatial reasoning and reasoning with proportions and graphs<br>• make and evaluate mathematical conjectures and arguments<br>• validate their own thinking<br>• appreciate the pervasive use and power of reasoning as a part of mathematics. | • make and test conjectures<br>• formulate counterexamples<br>• follow logical arguments<br>• judge the validity of arguments<br>• construct simple valid arguments. |
| (NCTM, p. 29) | (NCTM, p. 81) | (NCTM, p. 143) |

## Technology

Improvements in technology, and its increased availability in schools, have changed the focus of mathematics education. The time saved by using calculators or computers to perform complex calculations can be used to help students better understand mathematical concepts. Students can then understand the relationships among concepts and use these relationships to solve problems.

Calculators and computers can be used as tools to:

- develop concepts
- explore and demonstrate mathematical relationships and patterns
- organize and display data
- assist with solving problems and thus promote independence
- encourage students to be inquisitive and creative
- decrease the time spent on tedious computations
- reinforce the learning of basic number facts and properties
- develop an understanding of computational algorithms
- create geometric displays
- simulate situations.

In some cases, technology will allow teachers to ask questions requiring a high level of thinking and will allow students to solve complex, multifaceted problems. Technology can foster environments in which the growing curiosity of students can lead to rich mathematical discoveries. In these environments, the control of exploring mathematical ideas can be turned over to students.



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### Visualization

*Images are useful in describing the physical and mathematical environment.*

Visualization "involves thinking in *pictures* and *images* and the ability to perceive, transform and re-create different aspects of the visual–spatial world." (Armstrong, p. 10, italics in original) The use of images in the study of mathematics provides students with the opportunity to understand mathematical concepts and to make connections among them.

The physical environment is full of images. The images are of 3-D objects, 2-D shapes, 1-D lines and pictures. In geometry, the study of a 3-D object is assisted by visualizing either the net of 2-D shapes or the skeleton of 1-D lines required to construct the object.

The mathematical environment is full of images. These images are used to communicate mathematical concepts and multiple solutions to problems. At an elementary level, four piles, each containing three coins, can be used to represent $3 + 3 + 3 + 3 = 12$. Rearranging the piles into four rows of 3 can then be used to represent $4 \times 3 = 12$. Connecting the two images links the process of multiplication with that of repeated addition. At a more advanced level, analytic geometry describes figures algebraically and provides a tool for the visualization of algebraic relations. The analysis and interpretation of data using a visual summary aids in understanding the data and making predictions from it.

## NATURE OF MATHEMATICS

- *Change*
- *Constancy*
- *Dimension*
- *Number*
- *Pattern*
- *Quantity*
- *Relationships*
- *Shape*
- *Uncertainty*

By enriching our view of mathematics and the learning environment, the outcomes of this program of studies can be accomplished.

The brain is constantly looking for and making connections. "Because the learner is constantly searching for connections on many levels, educators need to orchestrate the experiences from which learners extract understanding. . . . Brain research establishes and confirms that multiple complex and concrete experiences are essential for meaningful learning and teaching." (Caine, p. 5)

There are additional critical components that must be addressed in a mathematics program beyond those listed as mathematical processes. The components discussed are: Change, Constancy, Dimension (size and scale), Number, Pattern, Quantity, Relationships, Shape and Uncertainty. They are used to describe mathematics in a broad way in order to establish the wide variety of connections that can be made among the various strands used to organize the outcomes central to this program of studies.

### Change

Change can be discussed from Kindergarten to Grade 12 across many aspects of mathematics. The study of change is often discussed in the context of calculus, and is often limited to this context. However, change is a much broader concept than that used in calculus. In order to make predictions, students need to describe and quantify their observations, attempt to build patterns, and identify those quantities that remain fixed and those quantities that change. For example, look at the pattern 4, 6, 8, 10, 12, . . . An elementary school student can describe this as skip counting by 2s, starting from 4. A senior high school student may describe this pattern as an arithmetic sequence, with first term 4, and a common difference of 2. Another student may describe it as a linear function with a discrete domain. All three interpretations are focusing on the changing size of the numbers within the sequence. To be able to understand change, students must become sensitive to patterns, such


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as linear, exponential, logarithmic and periodic. (Steen, p. 184)

### Constancy

Students are expected to communicate ideas visually, using diagrams and oral and written words, when describing constancy or invariance. Different aspects of constancy "are described by the terms stability, conservation, equilibrium, steady state, and symmetry." (AAAS–Benchmarks, p. 270) The most important properties in mathematics and science relate to those properties that do not change when outside conditions change. Elementary school students deal with constancy in situations where different methods are used to solve a single multiplication problem, such as finding the area of a 3-tile by 4-tile tabletop. Secondary students need to deal with constancy when they solve the more complicated multiplication problems that appear in determining the number of elements present in the sample spaces of probability problems. Many of these situations will involve permutations and combinations.

In geometry, a circle can be transformed into an ellipse by a simple stretch, and into a square by a more complex series of transformations; but there is no way that the circle can be transformed into a parabola. The closed figures, such as circles and squares, remain closed and cannot be transformed into open figures, such as parabolas. Triangles can be distorted in many ways, but all will have an angle sum of 180°. The straight line is characterized as having all its parts with the same slope. In solving many of the most important problems in mathematics, students need to concentrate on the properties that remain constant. This idea enables students to solve problems involving constant rates of change, lines with constant slope, direct variation situations, or the angle sums of polygons.

### Dimension (size and scale)

The concept of dimension, most usually associated with 3-D objects, 2-D figures or 1-D lines, needs to be developed within an environment of physical objects for all grades from Kindergarten to Grade 12. The prediction of the change in dimension of objects can be done using numbers attached to appropriate units. For example, with no knowledge of a formula, students in upper elementary grades can predict that doubling the side of a square generates four times the area. Junior and senior high school students need to be able to use algebraic structures to formalize this relationship.

Physical objects can all be described using measurement concepts. The development of perimeter, area and volume concepts relies on pattern recognition, not on memorization of formulas. Descriptions of geometric patterns (number of vertices, sides and edges of various 3-D objects, 2-D figures and 1-D lines); and the angle sum of various 2-D figures is also encouraged. This type of data should be placed in charts and/or graphs to help students visualize their findings and predict patterns.

### Number

Number, number systems and the operations on numbers are vital to all mathematics learning. The use of number must go beyond procedure and accuracy to include what is called number sense. Number sense includes:

- an intuitive feeling about numbers and their multiple relationships
- construction of the meaning of number through a variety of experiences, and development of an appreciation of the need for numbers beyond whole numbers (NCTM, p. 38)
- an appreciation and ability to make quick order of magnitude approximations (Steen, p. 79) with emphasis on establishing quick and accurate estimations for computation and measurement
- the ability to detect arithmetic errors
- knowledge of place value and the effects of arithmetic operations.

Many numerical calculations are performed with calculators and computers, and students must be able to determine if the desired calculations have been done correctly. Students must plan for the efficient use of technological tools.



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Number patterns should be recognized and used to count, to make predictions, to describe shapes and to compare.

**Pattern**

"What humans do with the language of mathematics is to describe patterns. Mathematics is an exploratory science that seeks to understand every kind of pattern. . . ." (Steen, p. 8) Patterns exist in number, geometry, algebra and data. By helping students recognize, extend, create and use patterns as a routine aspect of their lives, mathematics will become a useful tool to assist them in their systematic and intellectual understanding of their environment.

**Quantity**

"Quantitatively literate young need a flexible ability to identify critical relations in novel situations, to express these relations in effective symbolic form, to use computing tools to process information, and to interpret the results of those calculations." (Steen, p. 65)

Students have a strong desire to measure, code and order things. To this end, some of the outcomes are about single numbers, numbers attached to units of measure, and ordered sets of numbers. Other outcomes are about the interpretation of numbers and of number systems. The use of single numbers and of ordered pairs to describe phenomena in all aspects of mathematics, the natural sciences and the social sciences is very important.

With the growing use of technology to process numerical information, it is becoming essential for students to have a wide range of estimation skills so that they can evaluate whether or not the numerical output provided by a calculator or a computer is a reasonable solution to a given problem.

**Relationships**

The study of mathematics is the development of relationships between and among things. Part of mathematics should help students develop a sense of discovery that mathematicians over the years have felt and should prepare the way for students to make their own discoveries. Students should look for relationships among physical things, as well as the data used to describe those things. Descriptions of the attributes of objects are used to analyze symmetry and congruence and to classify things, using increasingly sophisticated language. Relationships will be described visually, symbolically, orally and in written form.

**Shape**

Shape in mathematics is central to geometry but also includes geometric representations of algebraic relations, the geometry of maps and the creation of networks of plane figures that can be used to construct 3-D objects. It is very important for students to look for and use similarities, congruences, patterns, transformations, dilatations and tessellations in the solution of a range of problems.

The use of language to describe shapes is an important aspect of mathematics. This description allows for the classification of objects according to various attributes, the naming of objects, and the analysis of objects. The study of shape can be used to build a deductive system, which can assist in further, more detailed analysis. Shape is used in the development of visual models in other disciplines, such as the use of molecular models in chemistry and biology.

The use of technology to analyze and depict shape will increase in importance for students of mathematics as more and better software and hardware become available in classrooms.

**Uncertainty**

Uncertainty involves data, chance, measurements and errors. Problems dealing with data, together with numbers in context found in the mass media, can be solved within the school mathematics program so long as the data provided and the problems posed have some meaning and relevance to students.



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Chance deals with the predictable and the unpredictable outcomes of events. Students from an early age are expected to deal with the concept of chance. As they mature, the language they use to describe chance becomes more sophisticated and involves the vocabulary of probability theory.

When dealing with random events and complex experiments, students can generate large quantities of data requiring analysis. The use of various technologies enables the student to summarize data easily and to create a visualization of the data to help identify patterns in the information. In some instances the functions describing patterns are linear, periodic, logarithmic or exponential, and senior high school students are expected to use the appropriate algebraic structures to model the information contained within the pattern.

The quality of the output information is directly related to the quality of the input data. The study of uncertainty allows students to assess the reliability of input data, and to learn the processes whereby input data is converted to output information.

## STRANDS

- *Number*
- *Patterns and Relations*
- *Shape and Space*
- *Statistics and Probability*

The student outcomes are organized within four strands. The strands are the formal aspects of the discipline of mathematics that form the foundation of this program of studies and act as connections across the grades. Four strands have been identified for the entire Kindergarten to Grade 12 mathematics framework to reinforce the interrelationship of mathematical concepts and skills. These strands are split into substrands. However, any such grouping into strands and substrands is for organizational purposes only, and does not reflect the connections among the strands and the underlying themes running throughout all of mathematics.

### Number

Number Concepts

*Students will:*
- use numbers to describe quantities
- represent numbers in multiple ways.

Number Operations

*Students will:*
- demonstrate an understanding of and proficiency with calculations
- decide which arithmetic operation or operations can be used to solve a problem and then solve the problem.

### Patterns and Relations

Patterns

*Students will:*
- use patterns to describe the world and to solve problems.

Variables and Equations

*Students will:*
- represent algebraic expressions in multiple ways.

Relations and Functions
[applies to Grades 10–12]

*Students will:*
- use algebraic and graphical models to generalize patterns, make predictions and solve problems.

### Shape and Space

Measurement

*Students will:*
- describe and compare everyday phenomena, using either direct or indirect measurement.


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3-D Objects and 2-D Shapes

*Students will:*
- describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.

Transformations

*Students will:*
- perform, analyze and create transformations.

**Statistics and Probability**

Data Analysis

*Students will:*
- collect, display and analyze data to make predictions about a population.

Chance and Uncertainty

*Students will:*
- use experimental or theoretical probability to represent and solve problems involving uncertainty.

## STUDENT EXPECTATIONS

The content is stated in terms of outcomes. These outcomes are measurable and identify what students are expected to know and do.

The outcomes are stated by strand, and within a grade, and are based on the expectation that they are appropriate to a large majority of the students. They are stated at the grade where they are expected to be "mastered". There may be some time delays between where students first encounter the learning and where they are expected to demonstrate knowledge of, or mastery in, that learning.

### General Outcomes

General outcomes are general statements that identify what students are expected to know and to be able to do upon completion of a grade.

### Specific Outcomes

Specific outcomes are statements identifying the component knowledge, skills and attitudes of a general outcome.

## INSTRUCTIONAL FOCUS

Each of the four strands is of significance. Therefore, considerable time should be spent on the concepts and processes identified in each strand.

Several additional considerations are important:

- Integration of the mathematical processes, within each strand, is encouraged and expected. A coding system with references to the seven mathematical processes appears after each specific outcome.

- By decreasing emphasis on rote calculation, drill and practice, and the size of numbers used in paper and pencil calculations, more time is available for concept development.

- Problem solving, reasoning and connections are vital to increasing mathematical power and must be integrated throughout the program. A minimum of half the available time within all strands needs to be dedicated to activities related to these processes.

- There is to be a balance between estimation and mental mathematics, paper and pencil exercises and the appropriate use of technology, including calculators and computers. Concepts should be introduced, using manipulatives, and gradually developed from the concrete to the pictorial to the symbolic.



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Strand: Number (Number Concepts)

*Students will:*

- use numbers to describe quantities
- represent numbers in multiple ways.

| | | | |
|---|---|---|---|
| **C** | Communication | **PS** | Problem Solving |
| **CN** | Connections | **R** | Reasoning |
| **E** | Estimation and Mental Mathematics | **T** | Technology |
| | | **V** | Visualization |

| Kindergarten | Grade 1 |
|---|---|
| **General Outcome**<br><br>Describe, orally, and compare quantities from 0 to 10, using number words in daily experiences.<br><br>**Specific Outcomes**<br><br>1. Count the number of objects in a set (0 to 10). [CN, V]<br>2. Build and compare sets of objects and describe the relationships among them, using the terms: more than, greater than, fewer than, less than, the same as and equal to (no written symbols). [C]<br>3. Order up to 2 sets of like objects based on the number of objects in each set. [PS]<br>4. Explore the representation of single-digit numerals, using a calculator or a computer to represent numerals on a screen. [PS, R, T] | **General Outcome**<br><br>Recognize and apply whole numbers from 0 to 100, and explore halves, in familiar settings.<br><br>**Specific Outcomes**<br><br>1. Count orally by 1s, 2s, 5s and 10s to 100. [C, CN]<br>2. Estimate, then count the number of objects in a set (0 to 50) and compare the estimate with the actual number. [C, E, T]<br>3. Recognize, build, compare and order sets that contain 0 to 50 elements. [V]<br>4. Read number words to 10. [C]<br>5. Represent and describe numbers to 50 in a variety of ways. [C, PS, R, V]<br>6. Explore the representation of numerals (0 to 50), using a calculator or a computer to display numerals. [PS, R, T]<br>7. Demonstrate, and explain orally, an understanding of halves as part of a shape or solid. [C, CN, V] |


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Strand: Number (Number Concepts)

*Students will:*

- use numbers to describe quantities
- represent numbers in multiple ways.

| | | | |
|---|---|---|---|
| **C** | Communication | **PS** | Problem Solving |
| **CN** | Connections | **R** | Reasoning |
| **E** | Estimation and Mental Mathematics | **T** | Technology |
| | | **V** | Visualization |

| Grade 2 | Grade 3 |
|---|---|
| **General Outcome**<br><br>Recognize and apply whole numbers up to 1000, and explore fractions (halves, thirds and quarters).<br><br>**Specific Outcomes**<br><br>1. Count to 1000 by 1s, 2s, 5s and 10s, and to 100 by 25s, using starting points that are multiples of 1, 2, 5, 10 and 25 respectively. [C, CN]<br>2. Estimate, then count the number of objects in a set (0 to 100), and compare the estimate with the actual number. [C, E, PS, R]<br>3. Recognize, build, compare and order sets that contain 0 to 100 elements. [V]<br>4. Represent and describe numbers to 100 in a variety of ways. [C, PS, R, V]<br>5. Demonstrate, concretely and pictorially, place value concepts to give meaning to numbers up to 100. [C, R, V]<br>6. Round numbers to the nearest ten. [E]<br>7. Read and write numerals to 100. [C, CN]<br>8. Read and write number words to 20. [C, CN, V]<br>9. Use ordinal numbers to 31. [C]<br>10. Explore the representation of numerals (0 to 100), using a calculator or a computer to display numerals. [PS, R, T]<br>11. Demonstrate if a number from 1 to 100 is even or odd. [C, CN]<br>12. Illustrate and explain halves, thirds and fourths as part of a region or a set. [C, R, V] | **General Outcome**<br><br>Develop a number sense for whole numbers 0 to 1000, and explore fractions (fifths and tenths).<br><br>**Specific Outcomes**<br><br>1. Count by 2s, 5s, 10s and 100s to 1000, using random starting points. [CN]<br>2. Count by 25s to 1000, using starting points that are multiples of 25. [C, CN]<br>3. Estimate, then count the number of objects in a set (0 to 1000), and compare the estimate with the actual number. [C, E]<br>4. Skip count backward by 2s, 5s, 10s and 100s, using starting points that are multiples of 2, 5, 10 and 100 respectively. [C, CN, T]<br>5. Demonstrate, concretely and pictorially, place value concepts to give meaning to numbers up to 1000. [C, R, V]<br>6. Recognize, build, compare and order sets that contain 0 to 1000 elements. [PS, R, V]<br>7. Round numbers to the nearest hundred. [E]<br>8. Read and write numerals to 1000. [C, CN, V]<br>9. Read and write number words to 100. [C, CN, V]<br>10. Use ordinal numbers to 100. [C]<br>11. Represent and describe numbers to 1000 in a variety of ways. [C, PS, R, T, V]<br>12. Recognize and explain if a number is divisible by 2, 5 or 10. [C, CN, R]<br>13. Illustrate and explain fifths and tenths as part of a region or a set. [C, R, V] |


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Strand: Number (Number Concepts)

*Students will:*

- use numbers to describe quantities
- represent numbers in multiple ways.

| | | | |
|---|---|---|---|
| C | Communication | PS | Problem Solving |
| CN | Connections | R | Reasoning |
| E | Estimation and Mental Mathematics | T | Technology |
| | | V | Visualization |

| Grade 4 | Grade 5 |
|---|---|
| **General Outcome**<br><br>Demonstrate a number sense for whole numbers 0 to 10 000, and explore proper fractions.<br><br>**Specific Outcomes**<br><br>1. Estimate, then count the number of objects in a set (0 to 1000), and compare the estimate with the actual number. [C, E]<br>2. Use skip counting (forward and backward) to support an understanding of patterns in multiplication and division. [C, CN]<br>3. Read and write numerals to 10 000. [R, V]<br>4. Read and write number words to 1000. [C, CN]<br>5. Compare and order whole numbers up to 10 000. [C]<br>6. Demonstrate, concretely, pictorially and symbolically, place value concepts to give meaning to numbers up to 10 000. [C, V, R, T]<br>7. Represent and describe numbers to 10 000 in a variety of ways. [C, PS, R, V]<br>8. Round numbers to the nearest thousand. [E]<br>9. Sort numbers into categories, using one or more attributes. [CN, R]<br>10. Illustrate and explain hundredths as part of a region or set. [C, R, V]<br>11. Connect proper fractions to decimals (tenths and hundredths), using manipulatives, diagrams and symbols. [CN, R, V] | **General Outcome**<br><br>Demonstrate a number sense for whole numbers 0 to 100 000, and explore proper fractions and decimals.<br><br>**Specific Outcomes**<br><br>1. Demonstrate, concretely and pictorially, an understanding of place value from hundredths. [C, R, V]<br>2. Read and write numerals to 100 000. [C, CN]<br>3. Read and write number words to 100 000. [C, CN, V]<br>4. Use estimation strategies for quantities up to 100 000. [E]<br>5. Recognize, model and describe multiples, factors, composites and primes. [C, R, V]<br>6. Compare and/or order whole numbers. [C, R, V]<br>7. Represent and describe proper fractions concretely, pictorially and symbolically. [CN, R, V]<br>8. Demonstrate and describe equivalent proper fractions concretely, pictorially and symbolically. [C, R, V]<br>9. Compare and/or order proper fractions and decimals to hundredths. [C, R, V] |


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Strand: Number (Number Concepts)

*Students will:*

- use numbers to describe quantities
- represent numbers in multiple ways.

| | | | |
|---|---|---|---|
| C | Communication | PS | Problem Solving |
| CN | Connections | R | Reasoning |
| E | Estimation and Mental Mathematics | T | Technology |
| | | V | Visualization |

| Grade 6 | Grade 7 |
|---|---|
| **General Outcome**<br><br>Develop a number sense for decimals and common fractions, explore integers, and show number sense for whole numbers.<br><br>**Specific Outcomes**<br><br>1. Read and write numerals greater than a million. [C, CN]<br>2. Estimate quantities up to a million. [E]<br>3. Distinguish among, and find, multiples, factors, composites and primes, using numbers 1 to 100. [R]<br>4. Recognize, model, identify, find and describe common multiples, common factors, least common multiple, greatest common factor and prime factorization, using numbers 1 to 100. [C, PS, R, V]<br>5. Explain the meaning of integers by extending counting numbers to less than zero. [R]<br>6. Identify practical applications of integers. [CN, PS]<br>7. Read and write numbers to thousandths. [C, CN, V]<br>8. Round numbers to the nearest unit, tenth and hundredth. [E]<br>9. Demonstrate and explain the meaning of improper fractions and mixed numbers (positive) concretely, pictorially and symbolically. [C, R, V]<br>10. Demonstrate and explain the meaning of ratio concretely, pictorially and symbolically. [C, CN, R, V]<br>11. Demonstrate and explain the meaning of percentage concretely, pictorially and symbolically. [C, CN, R, V] | **General Outcome**<br><br>Demonstrate a number sense for decimals and integers, including whole numbers.<br><br>**Specific Outcomes**<br><br>1. Define and use power, base and exponent to represent repeated multiplication. [C, T, V]<br>2. Write a whole number as:<br>• an expanded numeral, using powers of 10<br>• scientific notation, and vice versa.<br>[C, CN, V]<br>3. Use divisibility rules to determine if a number is divisible by 2, 3, 4, 5, 6, 9, 10. [CN, R]<br>4. Read and write numbers to any number of decimal places. [C, CN, V]<br>5. Demonstrate and describe equivalent mixed numbers and improper fractions concretely, pictorially and symbolically. [C, R, V]<br>6. Compare and/or order improper fractions, mixed numbers and decimals to thousandths. [R, T, V]<br>7. Recognize and illustrate that all fractions and mixed numbers can be represented in decimal form (include terminating and repeating decimals). [R, V]<br>8. Convert from terminating decimals to fractions. [R]<br>9. Convert from single-digit repeater ( $0.\dot{3}$ ) decimal numbers to fractions, using patterns. [CN, R, V]<br>10. Demonstrate, concretely and pictorially, that the sum of opposite integers is zero. [R, V]<br>11. Represent integers in a variety of concrete, pictorial and symbolic ways. [R, V]<br>12. Compare and order integers. [R, V] |


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Strand: Number (Number Operations)

*Students will:*

- demonstrate an understanding of and proficiency with calculations
- decide which arithmetic operation or operations can be used to solve a problem and then solve the problem.

| | | | |
|---|---|---|---|
| **C** | Communication | **PS** | Problem Solving |
| **CN** | Connections | **R** | Reasoning |
| **E** | Estimation and Mental Mathematics | **T** | Technology |
| | | **V** | Visualization |

| Kindergarten | Grade 1 |
|---|---|
| **General Outcome**<br>Demonstrate awareness of addition and subtraction. | **General Outcome**<br>Apply informal methods of addition and subtraction on whole numbers where the maximum sum is 18. |
| **Specific Outcomes**<br>5. Represent the processes of addition and subtraction through role playing and the use of manipulatives. [C, CN, PS, V] | **Specific Outcomes**<br>8. Use manipulatives and diagrams to demonstrate and describe the processes of addition and subtraction of numbers to 18.<br>**Note:** memorization not intended. [C, PS, R, V] |


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Strand: Number (Number Operations)

*Students will:*

- demonstrate an understanding of and proficiency with calculations
- decide which arithmetic operation or operations can be used to solve a problem and then solve the problem.

| | | | |
|---|---|---|---|
| C | Communication | PS | Problem Solving |
| CN | Connections | R | Reasoning |
| E | Estimation and Mental Mathematics | T | Technology |
| | | V | Visualization |

| Grade 2 | Grade 3 |
|---|---|
| **General Outcome**<br>Apply a variety of addition and subtraction strategies on whole numbers to 100, and use these operations in solving problems.<br>**Specific Outcomes**<br>13. Use manipulatives, diagrams and symbols to demonstrate and describe the processes of addition and subtraction of numbers to 100. [C, R, V]<br>14. Apply and explain multiple strategies to determine sums and differences on 2-digit numbers, with and without regrouping. [C, PS, R] | **General Outcome**<br>Apply an arithmetic operation (addition, subtraction, multiplication or division) on whole numbers, and illustrate its use in creating and solving problems.<br>**Specific Outcomes**<br>14. Use manipulatives, diagrams and symbols, in a problem-solving context, to demonstrate and describe the processes of addition and subtraction to 1000, with and without regrouping. [C, PS, R, V]<br>15. Use manipulatives, diagrams and symbols with maximum products and dividends to 50, to demonstrate and describe the processes of multiplication and division. [C, PS, V]<br>16. Recall addition/subtraction facts to 18 and multiplication facts to 49 ($7 \times 7$ on a multiplication grid). [E] |
| **General Outcome**<br>Use an appropriate calculation strategy or technology to solve problems.<br>**Specific Outcomes**<br>15. Apply a variety of estimation and mental mathematics strategies to addition and subtraction problems. [E, PS, T]<br>16. Recall addition and subtraction facts to 10. [E]<br>17. Demonstrate the processes of multiplication and division, using manipulatives and diagrams. [C, PS, V] | **General Outcome**<br>Use and justify an appropriate calculation strategy or technology to solve problems.<br>**Specific Outcomes**<br>17. Verify solutions to addition and subtraction problems, using estimation and calculators. [E, PS, T]<br>18. Verify solutions to addition and subtraction problems, using the inverse operation. [PS, R]<br>19. Justify the choice of method for addition and subtraction, using:<br>• estimation strategies<br>• mental mathematics strategies<br>• manipulatives<br>• algorithms<br>• calculators.<br>[C, PS, R, T]<br>20. Calculate products and quotients, using estimation strategies and mental mathematics strategies. [E, R] |


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Strand: Number (Number Operations)

*Students will:*

- demonstrate an understanding of and proficiency with calculations
- decide which arithmetic operation or operations can be used to solve a problem and then solve the problem.

| | | | |
|---|---|---|---|
| C | Communication | PS | Problem Solving |
| CN | Connections | R | Reasoning |
| E | Estimation and Mental Mathematics | T | Technology |
| | | V | Visualization |

| Grade 4 | Grade 5 |
|---|---|
| **General Outcome**<br><br>Apply arithmetic operations on whole numbers, and illustrate their use in creating and solving problems.<br><br>**Specific Outcomes**<br><br>12. Use manipulatives, diagrams and symbols, in a problem-solving context, to demonstrate and describe the process of addition and subtraction of numbers up to 10 000. [C, PS, R, V]<br>13. Demonstrate and describe the process of multiplication (3-digit by 1-digit), using manipulatives, diagrams and symbols. [C, PS, R, T, V]<br>14. Demonstrate and describe the process of division (2-digit by a 1-digit), using manipulatives, diagrams and symbols. [C, PS, R, V]<br>15. Recall multiplication and division facts to 81 ($9 \times 9$ on a multiplication grid). [E] | **General Outcome**<br><br>Apply arithmetic operations on whole numbers and decimals, and illustrate their use in creating and solving problems.<br><br>**Specific Outcomes**<br><br>10. Add and subtract decimals to hundredths, concretely, pictorially and symbolically. [PS, V]<br>11. Estimate, mentally calculate, compute or verify, the product (3-digit by 2-digit) and quotient (3-digit divided by 1-digit) of whole numbers. [E, PS, T]<br>12. Multiply and divide decimals to hundredths, concretely, pictorially and symbolically, using single-digit, whole number multipliers and divisors. [PS, V]<br>13. Solve problems involving multiple steps and multiple operations, and accept that other methods may be equally valid. [PS] |
| **General Outcome**<br><br>Use and justify an appropriate calculation strategy or technology to solve problems.<br><br>**Specific Outcomes**<br><br>16. Verify solutions to multiplication and division problems, using estimation and calculators. [E, PS, R, T]<br>17. Verify solutions to multiplication and division problems, using the inverse operation. [PS, R]<br>18. Justify the choice of method for multiplication and division, using:<br>• estimation strategies<br>• mental mathematics strategies<br>• manipulatives<br>• algorithms<br>• calculators.<br>[C, PS, R, T, V] | |
| **General Outcome**<br><br>Demonstrate an understanding of addition and subtraction of decimals.<br><br>**Specific Outcomes**<br><br>19. Demonstrate an understanding of addition and subtraction of decimals (tenths and hundredths), using concrete and pictorial representations. [C, PS, V] | |


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Strand: Number (Number Operations)

*Students will:*

- demonstrate an understanding of and proficiency with calculations
- decide which arithmetic operation or operations can be used to solve a problem and then solve the problem.

| | | | |
|---|---|---|---|
| C | Communication | PS | Problem Solving |
| CN | Connections | R | Reasoning |
| E | Estimation and Mental Mathematics | T | Technology |
| | | V | Visualization |

## Grade 6

**General Outcome**

Apply arithmetic operations on whole numbers and decimals in solving problems.

**Specific Outcomes**

12. Solve problems that involve arithmetic operations on decimals to thousandths, using appropriate technology (2-digit whole number multipliers and dividers). [PS, R, T]
13. Estimate the solution to calculations involving whole numbers and decimals (2-digit whole number multipliers and divisors). [E, PS, R]
14. Use a variety of methods to solve problems with multiple solutions. [PS, R, T, V]

## Grade 7

**General Outcome**

Apply arithmetic operations on decimals and integers, and illustrate their use in solving problems.

**Specific Outcomes**

13. Use patterns, manipulatives and diagrams to demonstrate the concepts of multiplication and division by a decimal. [CN, PS, R, V]
14. Use estimation strategies to justify or assess the reasonableness of calculations. [E, PS]
15. Add, subtract, multiply and divide decimals (for more than 2-digit divisors or multipliers, the use of technology is expected). [E, PS, T]
16. Add, subtract, multiply and divide integers concretely, pictorially and symbolically. [PS, V]
17. Illustrate and explain the order of operations, using paper and pencil or a calculator. [PS, T, V]

**General Outcome**

Illustrate the use of rates, ratios, percentages and decimals in solving problems.

**Specific Outcomes**

18. Estimate and calculate percentages. [E, PS]
19. Distinguish between rate and ratio, and use them to solve problems. [PS]
20. Explain, demonstrate and use proportion in solving problems. [C, PS, V]
21. Convert, mentally, among fractions, decimals and per cents to facilitate the solution of problems. [E, PS]


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Strand: Patterns and Relations (Patterns)

*Students will:*

- use patterns to describe the world and to solve problems.

| | | | |
|---|---|---|---|
| C | Communication | PS | Problem Solving |
| CN | Connections | R | Reasoning |
| E | Estimation and Mental Mathematics | T | Technology |
| | | V | Visualization |

| Kindergarten | Grade 1 |
|---|---|
| **General Outcome**<br>Identify and create patterns arising from daily experiences. | **General Outcome**<br>Identify, create and compare patterns arising from daily experiences in the classroom. |
| **Specific Outcomes**<br>1. Sort objects, using a single attribute. [CN, R, V]<br>2. Recognize and reproduce a pattern, using actions and manipulatives. [C, CN, PS, V]<br>3. Extend and create a pattern, using actions and manipulatives. [C, CN, PS, R, V]<br>4. Describe, orally, a pattern. [C, CN] | **Specific Outcomes**<br>1. Sort objects, using a single given attribute determined by the student. [CN, PS, V]<br>2. Identify, name and reproduce patterns, using actions, manipulatives, diagrams and spoken terms. [C, PS, R, V]<br>3. Extend and create patterns, using actions, manipulatives, diagrams and spoken terms. [C, CN, PS, R, V]<br>4. Compare patterns, using actions, manipulatives, diagrams and spoken terms. [C, CN, V]<br>5. Begin to recognize patterns in the environment. [CN, PS, V] |


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Strand: Patterns and Relations (Patterns)

*Students will:*

- use patterns to describe the world and to solve problems.

| | | | |
|---|---|---|---|
| C | Communication | PS | Problem Solving |
| CN | Connections | R | Reasoning |
| E | Estimation and Mental Mathematics | T | Technology |
| | | V | Visualization |

| Grade 2 | Grade 3 |
|---|---|
| **General Outcome**<br><br>Identify, create, describe and translate numerical and non-numerical patterns arising from daily experiences in the school and on the playground.<br><br>**Specific Outcomes**<br><br>1. Sort objects and shapes, using one or two attributes. [CN, PS, V]<br>2. Identify attributes and rules in presorted sets. [C, R]<br>3. Identify and describe patterns, including numerical and non-numerical patterns. [C, CN, PS]<br>4. Create, extend and describe patterns, including numerical and non-numerical patterns. [C, PS, T, V]<br>5. Translate patterns from one mode to another: manipulatives, diagrams, charts, calculators, words, symbols. [C, CN, T, V] | **General Outcome**<br><br>Investigate, establish and communicate rules for numerical and non-numerical patterns, including those found in the home, and use these rules to make predictions.<br><br>**Specific Outcomes**<br><br>1. Sort, concretely and pictorially, using two or more attributes. [CN, PS, V]<br>2. Use objects and concrete models to explain the rule for a pattern, such as those found on addition and multiplication charts. [C, R, V]<br>3. Make predictions based on addition and multiplication patterns. [PS, R] |


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Strand: Patterns and Relations (Patterns)

*Students will:*

- use patterns to describe the world and to solve problems.

| | | | |
|---|---|---|---|
| **C** | Communication | **PS** | Problem Solving |
| **CN** | Connections | **R** | Reasoning |
| **E** | Estimation and Mental Mathematics | **T** | Technology |
| | | **V** | Visualization |

| Grade 4 | Grade 5 |
|---|---|
| **General Outcome**<br><br>Investigate, establish and communicate rules for, and predictions from, numerical and non-numerical patterns, including those found in the community.<br><br>**Specific Outcomes**<br><br>1. Identify and explain mathematical relationships and patterns, using:<br>• grids/tables/objects<br>• Venn/Carroll/tree diagrams<br>• graphs<br>• objects or models<br>• technology.<br>[C, CN, PS, R, T]<br>2. Make and justify predictions, using numerical and non-numerical patterns. [C, PS, R] | **General Outcome**<br><br>Construct, extend and summarize patterns, including those found in nature, using rules, charts, mental mathematics and calculators.<br><br>**Specific Outcomes**<br><br>1. Develop charts to record and reveal patterns. [CN, PS]<br>2. Describe how a pattern grows, using everyday language in spoken and written form. [C, CN]<br>3. Construct and expand patterns in two and three dimensions, concretely and pictorially. [PS, V]<br>4. Generate and extend number patterns from a problem-solving context. [PS, R]<br>5. Predict and justify pattern extensions. [C, R] |


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Strand: Patterns and Relations (Patterns)

*Students will:*

- use patterns to describe the world and to solve problems.

| | | | |
|---|---|---|---|
| C | Communication | PS | Problem Solving |
| CN | Connections | R | Reasoning |
| E | Estimation and Mental Mathematics | T | Technology |
| | | V | Visualization |

| Grade 6 | Grade 7 |
|---|---|
| **General Outcome**<br>Use relationships to summarize, generalize and extend patterns, including those found in music and art. | **General Outcome**<br>Express patterns, including those used in business and industry, in terms of variables, and use expressions containing variables to make predictions. |
| **Specific Outcomes**<br>1. Represent, visually, a pattern to clarify relationships and to verify predictions. [C, R, V]<br>2. Summarize a relationship, using everyday language in spoken or written form. [C, R]<br>3. Create expressions and rules to describe, complete and extend patterns and relationships. [C, CN, PS, R]<br>4. Find approximate number values from a given graph. [PS, R] | **Specific Outcomes**<br>1. Predict and justify possible *n*th values of a number pattern. [C, CN, R]<br>2. Interpolate and extrapolate number values from a given graph. [E, PS, V]<br>3. Graph relations, analyze the result and draw a conclusion from a pattern. [R, V]<br>4. Use patterns and relations to represent simple oral and written expressions as mathematical symbols, and vice versa. [CN, PS, R] |


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Strand: Patterns and Relations (Variables and Equations)

*Students will:*

- represent algebraic expressions in multiple ways.

| | | | |
|---|---|---|---|
| **C** | Communication | **PS** | Problem Solving |
| **CN** | Connections | **R** | Reasoning |
| **E** | Estimation and Mental Mathematics | **T** | Technology |
| | | **V** | Visualization |

| Kindergarten | Grade 1 |
|---|---|
| [no outcomes at this grade level] | [no outcomes at this grade level] |


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Strand: Patterns and Relations (Variables and Equations)

*Students will:*

- represent algebraic expressions in multiple ways.

| | | | |
|---|---|---|---|
| **C** | Communication | **PS** | Problem Solving |
| **CN** | Connections | **R** | Reasoning |
| **E** | Estimation and Mental Mathematics | **T** | Technology |
| | | **V** | Visualization |

| Grade 2 | Grade 3 |
|---|---|
| [no outcomes at this grade level] | [no outcomes at this grade level] |


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Strand: Patterns and Relations (Variables and Equations)

*Students will:*

- represent algebraic expressions in multiple ways.

| | | | |
|---|---|---|---|
| C | Communication | PS | Problem Solving |
| CN | Connections | R | Reasoning |
| E | Estimation and Mental Mathematics | T | Technology |
| | | V | Visualization |

| Grade 4 | Grade 5 |
|---|---|
| [no outcomes at this grade level] | [no outcomes at this grade level] |


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Strand: Patterns and Relations (Variables and Equations)

*Students will:*

- represent algebraic expressions in multiple ways.

| | | | |
|---|---|---|---|
| C | Communication | PS | Problem Solving |
| CN | Connections | R | Reasoning |
| E | Estimation and Mental Mathematics | T | Technology |
| | | V | Visualization |

| Grade 6 | Grade 7 |
|---|---|
| **General Outcome**<br><br>Use informal and concrete representations of equality and operations on equality to solve problems.<br><br>**Specific Outcomes**<br><br>5. Demonstrate and explain the meaning and preservation of equality by balancing objects, or by using models and diagrams. [C, CN, PS, R, V]<br>6. Use pre-algebra strategies to solve equations with one unknown and with whole number coefficients and solutions. [PS, R] | **General Outcome**<br><br>Use variables and equations to express, summarize and apply relationships as problem-solving tools in a restricted range of contexts.<br><br>**Specific Outcomes**<br><br>5. Write mathematical expressions that arise from problem-solving contexts. [C, CN, PS]<br>6. Evaluate expressions with and without concrete models. [R, V]<br>7. Illustrate the solution process for a one-step, single-variable, first-degree equation, using concrete materials or diagrams. [CN, PS, V]<br>8. Solve and verify one-step linear equations, using a variety of techniques. [PS, R]<br>9. Explain how to solve simple problems, using informal algebraic methods. [C, PS, R] |


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Strand: Shape and Space (Measurement)

*Students will:*

- describe and compare everyday phenomena, using either direct or indirect measurement.

| | | | |
|---|---|---|---|
| C | Communication | PS | Problem Solving |
| CN | Connections | R | Reasoning |
| E | Estimation and Mental Mathematics | T | Technology |
| | | V | Visualization |

| Kindergarten | Grade 1 |
|---|---|
| **General Outcome**<br><br>Demonstrate awareness of measurement.<br><br>**Specific Outcomes**<br><br>1. Classify and describe linear attributes of objects; e.g., long, short. [C]<br>2. Arrange objects in order of size, by length or by height. [E, PS]<br>3. Cover a surface with a variety of objects. [PS, V]<br>4. Use the words full, empty, less and more, to talk about volume and capacity. [C]<br>5. Use the words heavier or lighter, to talk about the mass (weight) of two objects. [C]<br>6. Use the terms long time or short time, to talk about the duration of events. [C]<br>7. Use words like hot, hotter; cold, colder; warm, warmer; cool, cooler to talk about temperature. [C]<br>8. Exchange play money for objects in a play store. [E, PS] | **General Outcome**<br><br>Estimate, measure and compare, using whole numbers and nonstandard units of measure.<br><br>**Specific Outcomes**<br><br>1. Select an appropriate nonstandard unit to measure length. [R, V]<br>2. Estimate, measure, record, compare and order objects by length, height and distance around, using nonstandard units. [E, PS]<br>3. Estimate the number of uniform objects or shapes that will cover the surface of a design, and verify by covering and counting. [E, V]<br>4. Estimate the number of irregular shapes that will cover a given area, and verify by covering and counting. [E, V]<br>5. Estimate, measure, record and compare the volume/capacity of containers, using nonstandard units. [E, PS]<br>6. Estimate, measure, record and compare the mass (weight) of objects, using nonstandard units. [E, PS]<br>7. Recognize that different objects may have the same mass (weight). [CN]<br>8. Estimate and measure the passage of time related to nonstandard units. [E]<br>9. Sequence events within one day and over several days. [R]<br>10. Compare the duration of activities. [E]<br>11. Describe the time of day; e.g., morning, afternoon. [C]<br>12. Name, in order, the days of the week and the seasons of the year. [C]<br>13. Describe and compare temperatures, using the senses. [C, E]<br>14. Recognize and name coins: pennies, nickels, dimes, quarters, one dollar. [C]<br>15. State the value, in cents, of pennies, nickels and dimes. [C]<br>16. Create equivalent sets of coins up to 10¢ in value. [PS, R] |


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Strand: Shape and Space (Measurement)

*Students will:*

- describe and compare everyday phenomena, using either direct or indirect measurement.

| | | | |
|---|---|---|---|
| C | Communication | PS | Problem Solving |
| CN | Connections | R | Reasoning |
| E | Estimation and Mental Mathematics | T | Technology |
| | | V | Visualization |

| Grade 2 | Grade 3 |
|---|---|
| **General Outcome**<br><br>Estimate, measure and compare, using standard units for length and primarily nonstandard units for other measures.<br><br>**Specific Outcomes**<br><br>1. Construct items of specific lengths (cm, dm, m). [E, V]<br>2. Select the most appropriate standard unit (cm, dm, m) to measure a length. [E, V]<br>3. Estimate, measure, record, compare and order objects by length, height and distance around, using standard units (cm, dm, m). [E, PS]<br>4. Estimate, measure, record and compare the area of shapes, using nonstandard units. [E, PS]<br>5. Construct a shape given a specific area in nonstandard units. [PS, V]<br>6. Estimate, measure, record, compare and order the capacity of containers, using nonstandard units. [E, PS]<br>7. Estimate, measure, record, compare and order the mass (weight) of objects, using nonstandard units. [E, PS]<br>8. Recognize that the size and shape of an object does not necessarily determine its mass (weight). [CN]<br>9. Estimate and measure the passage of time related to minutes and hours. [E]<br>10. Select the most appropriate standard unit to measure a given period of time. [E, R]<br>11. Name, in order, the months of the year. [C]<br>12. Relate the number of days to a week, months to a year, minutes to an hour, hours to a day. [CN]<br>13. Read the date on a calendar. [C]<br>14. Use a thermometer to determine rising and falling temperatures. [CN]<br>15. Create equivalent sets of coins, using pennies, nickels and dimes, up to $1 in value. [PS, R]<br>16. Estimate, count and record, using the cents symbol only, the value of collections of coins up to $1. [E]<br>17. Recognize and state the value, in cents, of a quarter, a dollar and bills to $10. [C] | **General Outcome**<br><br>Estimate, measure and compare, using whole numbers and primarily standard units of measure.<br><br>**Specific Outcomes**<br><br>1. Select the most appropriate standard unit, including km, to measure length. [E, R, V]<br>2. Describe the relationships among cm, dm and m. [C]<br>3. Estimate, measure, record, compare and order objects by length, height and perimeter, using standard units. [E, PS]<br>4. Select an appropriate nonstandard unit to measure area. [E, V]<br>5. Estimate, measure, record, compare and order shapes by area, using nonstandard units. [E, PS]<br>6. Construct a variety of shapes given a specific area in nonstandard units. [PS, V]<br>7. Select an appropriate object or nonstandard unit to measure capacity or volume of a container. [E, V]<br>8. Estimate, measure, record, compare and order containers by volume/capacity, using:<br>• nonstandard units<br>• litres.<br>[E, PS]<br>9. Estimate, measure, record, compare and order the mass (weight) of objects, using standard units (g, kg). [E, PS]<br>10. Construct objects to equal a given mass (weight). [PS]<br>11. Estimate and measure the passage of time, using standard units; seconds, minutes, hours, days, weeks, months, years. [E]<br>12. Read and write the days of the week and months of the year. [C]<br>13. Relate days to years. [CN]<br>14. Read digital clocks and write time to the nearest minute, using 12-hour notation. [C]<br>15. Estimate, read and record temperature to the nearest degree C. [E]<br>15. Relate temperature to everyday situations. [CN]<br>15. Create and recognize that a given value of money can be represented in many different ways. [PS, R]<br>15. Estimate, count and record collections of coins and bills up to $10. [E]<br>19. Make purchases and change up to $10. [PS]<br>20. Read and write both money notations (89¢ and $0.89). [C]<br>21. Recognize the value of bills up to $100. [C] |


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Strand: Shape and Space (Measurement)

*Students will:*

- describe and compare everyday phenomena, using either direct or indirect measurement.

| | | | |
|---|---|---|---|
| **C** | Communication | **PS** | Problem Solving |
| **CN** | Connections | **R** | Reasoning |
| **E** | Estimation and Mental Mathematics | **T** | Technology |
| | | **V** | Visualization |

| Grade 4 | Grade 5 |
|---|---|
| **General Outcome**<br>Estimate, measure and compare, using decimal numbers and standard units of measure. | **General Outcome**<br>Use measurement concepts, appropriate tools and results of measurements to solve problems in everyday contexts. |
| **Specific Outcomes**<br>1. Construct items of specific lengths, including mm. [E, V]<br>2. Select the most appropriate standard unit to measure length. [E, R, V]<br>3. Describe the relationships among mm, cm, dm, m and km. [C]<br>4. Estimate, measure, record, compare and order objects by length, height, perimeter and circumference, using standard units. [E, PS]<br>5. Estimate, measure, record, compare and order shapes by area, using standard units ($cm^2$, $m^2$). [E, PS]<br>6. Construct a number of shapes given a specific area ($cm^2$). [PS]<br>7. Select the most appropriate standard unit to measure area. [E, V]<br>8. Relate the size of a unit to the number of units used to measure:<br>• length<br>• volume/capacity<br>• area.<br>[CN, R]<br>9. Estimate, measure, record, compare and order the capacity of containers, using standard units (mL, L). [E, PS]<br>10. Describe the relationship between g and kg. [C]<br>11. Solve problems involving mass (weight), using g and kg. [PS]<br>12. Relate the size of a unit to the number of units used to measure mass (weight). [R]<br>13. Relate years to decades; decades to centuries; centuries to millenniums. [CN]<br>14. Read an analog clock to the nearest 5 minutes, and write time, using am and pm. [C]<br>15. Estimate, count and record collections of coins and bills up to $50. [E]<br>16. Make purchases and change up to $50. [PS] | **Specific Outcomes**<br>1. Recognize and explain the meaning of length, width, height, depth, thickness, perimeter and circumference. [C]<br>2. Evaluate the appropriateness of units and measuring tools in practical contexts. [CN]<br>3. Estimate and measure the perimeter of irregular shapes. [E, R]<br>4. Estimate and measure the area of irregular shapes by dividing them into parts. [E, R]<br>5. Estimate and measure the effect of changing one or more dimensions of a rectangle on its:<br>• perimeter<br>• area.<br>[E, R]<br>6. Relate perimeter and area of rectangles, using manipulatives and diagrams. [CN, R]<br>7. Estimate, measure, record and order containers by volume, using $cm^3$. [E, PS]<br>8. Use concrete materials to relate $cm^3$ to mL. [CN, V]<br>9. Construct objects of a specific volume, expressed in $cm^3$. [PS]<br>10. Solve problems involving mass (weight), using g, kg and t. [PS]<br>11. Read an analog clock to the nearest minute, and write the time. [C]<br>12. Read and write time on a 24-hour clock. [C]<br>13. Read and write SI notation for recording date and time. [C] |


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Strand: Shape and Space (Measurement)

*Students will:*

- describe and compare everyday phenomena, using either direct or indirect measurement.

| | | | |
|---|---|---|---|
| C | Communication | PS | Problem Solving |
| CN | Connections | R | Reasoning |
| E | Estimation and Mental Mathematics | T | Technology |
| | | V | Visualization |

| Grade 6 | Grade 7 |
|---|---|
| **General Outcome**<br><br>Solve problems involving perimeter, area, surface area, volume and angle measurement.<br><br>**Specific Outcomes**<br><br>1. Use conversions among commonly used SI units of length, mass (weight) and capacity (volume) to solve problems. [E, PS]<br>2. Develop, verify and use rules or expressions for the perimeter of polygons. [CN, PS, R]<br>3. Develop, verify and apply rules or expressions for the area of rectangles ($mm^2$, $cm^2$, $m^2$, ha and $km^2$). [CN, PS, R]<br>4. Estimate and determine the surface area of a right rectangular prism, without using a formula. [E, PS]<br>5. Discover, generalize and use rules for the volume of right rectangular prisms. [PS, R]<br>6. Design and construct rectangles, given one or both of perimeter and area, using whole numbers. [PS, R]<br>7. Demonstrate concretely, pictorially and symbolically that many rectangles are possible for a given perimeter or a given area. [CN, R]<br>8. Determine the volume of an object by measuring the displacement of a liquid by that object ($cm^3$ or mL). [PS, R]<br>9. Recognize angles as being more than 90 degrees, equal to 90 degrees, less than 90 degrees, equal to 180 degrees, greater than 180 degrees. [V]<br>10. Estimate and measure angles, using a circular protractor. [E]<br>11. Sketch and draw an angle when the degree measure is specified. [E, V]<br>12. Classify given angles as acute, right, obtuse, straight and reflex. [E]<br>13. Identify and compare examples of angles in the environment. [CN, V] | **General Outcome**<br><br>Solve problems involving the properties of circles and their connections with angles and time zones.<br><br>**Specific Outcomes**<br><br>1. Measure the diameters, radii and circumferences of circles, and establish the relationships among them. [CN, R]<br>2. Solve problems involving the radii, diameters and circumferences of circles. [PS, T]<br>3. Explain how time zones are determined. [C, PS]<br>4. Research and report how measurement instruments are used in the community. [C, CN] |


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Strand: Shape and Space (3-D Objects and 2-D Shapes)

*Students will:*

- describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.

| | | | |
|---|---|---|---|
| **C** | Communication | **PS** | Problem Solving |
| **CN** | Connections | **R** | Reasoning |
| **E** | Estimation and Mental Mathematics | **T** | Technology |
| | | **V** | Visualization |

| Kindergarten | Grade 1 |
|---|---|
| **General Outcome**<br>Sort, classify and build real-world objects.<br><br>**Specific Outcomes**<br>9. Identify, sort and classify 3-D objects in the environment. [CN, R]<br>10. Describe, and discuss orally, objects, using such words as big, little, round, like a box, like a can. [C]<br>11. Build 3-D objects. [PS, V] | **General Outcome**<br>Explore and classify 3-D objects and 2-D shapes, according to their properties.<br><br>**Specific Outcomes**<br>17. Explore, classify and describe 3-D objects according to two attributes. [C, PS, R, V]<br>18. Observe and build a given 3-D object. [E, PS, V]<br>19. Identify, name and describe specific 2-D shapes as:<br>• circles<br>• triangles<br>• rectangles.<br>[C, R]<br>20. Compare, sort and classify 2-D shapes. [CN, E, R] |


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Strand: Shape and Space (3-D Objects and 2-D Shapes)

*Students will:*

- describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.

| | | | |
|---|---|---|---|
| C | Communication | PS | Problem Solving |
| CN | Connections | R | Reasoning |
| E | Estimation and Mental Mathematics | T | Technology |
| | | V | Visualization |

| Grade 2 | Grade 3 |
|---|---|
| **General Outcome**<br><br>Name, describe and construct a variety of 3-D objects and 2-D shapes.<br><br>**Specific Outcomes**<br><br>18. Explore faces, vertices and edges of 3-D objects. [R]<br>19. Identify, name and describe specific 3-D objects as:<br>• cubes<br>• spheres<br>• cones<br>• cylinders<br>• pyramids.<br>[C]<br>20. Build a skeleton of a 3-D object, and describe how the skeleton relates to the object. [E, PS, V]<br>21. Build and rearrange a pattern, using a set of 2-D shapes. [E, PS, V]<br>22. Match and make identical (congruent) 2-D shapes. [PS, T, V] | **General Outcome**<br><br>Describe, classify, construct and relate 3-D objects and 2-D shapes.<br><br>**Specific Outcomes**<br><br>22. Identify and count faces, vertices and edges of 3-D objects. [E]<br>23. Identify and name faces of a 3-D object with appropriate 2-D names. [C, V]<br>24. Describe and name pyramids and prisms by the shape of the base. [C]<br>25. Demonstrate that a rectangular solid has more than one net. [PS, V]<br>26. Compare and contrast two 3-D objects. [C, CN]<br>27. Recognize congruent (identical) 3-D objects and 2-D shapes. [CN]<br>28. Explore, concretely, the concepts of perpendicular, parallel and intersecting lines on 3-D objects. [R, V] |


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Strand: Shape and Space (3-D Objects and 2-D Shapes)

*Students will:*

- describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.

| | | | |
|---|---|---|---|
| C | Communication | PS | Problem Solving |
| CN | Connections | R | Reasoning |
| E | Estimation and Mental Mathematics | T | Technology |
| | | V | Visualization |

| Grade 4 | Grade 5 |
|---|---|
| **General Outcome**<br><br>Describe, classify, construct and relate 3-D objects and 2-D shapes, using mathematical vocabulary.<br><br>**Specific Outcomes**<br><br>17. Design and construct nets for pyramids and prisms. [E, PS, V]<br>18. Relate nets to 3-D objects. [CN, V]<br>19. Compare and contrast:<br>• pyramids<br>• prisms<br>• pyramids and prisms.<br>[C, R]<br>20. Recognize, from everyday experience, and identify:<br>• point<br>• line<br>• parallel lines<br>• intersecting lines<br>• perpendicular lines<br>• vertical lines<br>• horizontal lines.<br>[C, V]<br>21. Classify angles in a variety of orientations according to whether they are right angle, less than right angle, or greater than right angle. [E, V]<br>22. Identify and sort specific quadrilaterals, including squares, rectangles, parallelograms and trapezoids. [R, V] | **General Outcome**<br><br>Use visualization of 3-D objects and 2-D shapes to solve problems related to spatial relations.<br><br>**Specific Outcomes**<br><br>14. Construct, analyze and classify triangles according to the side measures. [E, R, V]<br>15. Build, represent and describe geometric objects and shapes. [C, PS]<br>16. Identify and name polygons according to the number of sides, angles and vertices (3, 4, 5, 6 or 8). [C, R, V]<br>17. Cover a given 2-D shape with tangram pieces. [PS, V]<br>18. Complete the drawing of a 3-D object, on grid paper, given the front face. [E, V]<br>19. Determine, experimentally, the minimum information needed to draw a given 2-D shape. [R, V] |


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Strand: Shape and Space (3-D Objects and 2-D Shapes)

*Students will:*

- describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.

| | | | |
|---|---|---|---|
| C | Communication | PS | Problem Solving |
| CN | Connections | R | Reasoning |
| E | Estimation and Mental Mathematics | T | Technology |
| | | V | Visualization |

| Grade 6 | Grade 7 |
|---|---|
| **General Outcome**<br>Use visualization and symmetry to solve problems involving classification and sketching. | **General Outcome**<br>Link angle measures to the properties of parallel lines. |
| **Specific Outcomes**<br>14. Classify triangles according to the measures of their angles. [C, E]<br>15. Sort quadrilaterals and regular polygons according to the number of lines of symmetry. [V]<br>16. Reproduce a given geometric drawing on grid paper. [V]<br>17. Sketch 3-D solids and skeletons with and without grids. [PS, T, V]<br>18. Recognize and appreciate optical illusions. [V] | **Specific Outcomes**<br>5. Measure and classify pairs of angles as complementary or supplementary angles. [E]<br>6. Investigate, identify and name pairs of angles pertaining to parallel lines and transversals, including:<br>• corresponding<br>• vertically opposite<br>• interior on the same side of the transversal<br>• exterior on the same side of the transversal<br>• alternate angles.<br>[C, V]<br>7. Describe the relationships between the pairs of angles pertaining to parallel lines and transversals. [C, R, T]<br>8. Explain, in more than one way, why the sum of the measures of the angles of a triangle is 180°. [C, R, T]<br>9. Use mathematical reasoning to determine the measures of angles in a diagram. [R, V]<br>10. Construct angle bisectors and perpendicular bisectors. [R, T, V] |


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Strand: Shape and Space (Transformations)

*Students will:*

- perform, analyze and create transformations.

| | | | |
|---|---|---|---|
| C | Communication | PS | Problem Solving |
| CN | Connections | R | Reasoning |
| E | Estimation and Mental Mathematics | T | Technology |
| | | V | Visualization |

| Kindergarten | Grade 1 |
|---|---|
| **General Outcome**<br>Describe, orally, the position of 3-D objects. | **General Outcome**<br>Describe, orally, the relative position of 3-D objects and 2-D shapes. |
| **Specific Outcomes**<br>12. Describe the relative position of 3-D objects, using such words as over, under, beside, between, inside, outside. [C] | **Specific Outcomes**<br>21. Describe the relative position of 3-D objects and 2-D shapes, using such words as near, far, left, right. [C]<br>22. Match size and shape of figures by superimposing one on top of the other. [E]<br>23. Explore and describe reflections in a mirror. [CN, V] |


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Strand: Shape and Space (Transformations)

*Students will:*

- perform, analyze and create transformations.

| | | | |
|---|---|---|---|
| **C** | Communication | **PS** | Problem Solving |
| **CN** | Connections | **R** | Reasoning |
| **E** | Estimation and Mental Mathematics | **T** | Technology |
| | | **V** | Visualization |

| Grade 2 | Grade 3 |
|---|---|
| **General Outcome**<br>Apply positional language, orally and in writing, to communicate motion. | **General Outcome**<br>Use numbers and direction words to describe the relative positions of objects in one dimension, using everyday contexts. |
| **Specific Outcomes**<br>23. Communicate and apply positional language in oral, written or numerical form. [C]<br>24. Create symmetrical 2-D shapes by folding and reflecting. [PS, V] | **Specific Outcomes**<br>29. Communicate and apply terms of direction, such as north or south and east or west, and relate to maps. [C, CN, T]<br>30. Graph whole number points on a horizontal number line or a vertical number line. [CN, V]<br>31. Trace a path, using oral or written instructions. [C, PS] |


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Strand: Shape and Space (Transformations)

*Students will:*

- perform, analyze and create transformations.

| | | | |
|---|---|---|---|
| C | Communication | PS | Problem Solving |
| CN | Connections | R | Reasoning |
| E | Estimation and Mental Mathematics | T | Technology |
| | | V | Visualization |

| Grade 4 | Grade 5 |
|---|---|
| **General Outcome**<br>Use numbers and direction words to describe the relative positions of objects in two dimensions, using everyday contexts.<br>**Specific Outcomes**<br>23. Communicate and apply terms of direction, such as north, south, east, west, and relate to maps and grids. [T]<br>24. Place an object on a grid, using columns and rows. [C, CN]<br>25. Trace a path, using oral or written instructions, and write instructions for a given path. [C, PS, T]<br>26. Create and verify symmetrical 2-D shapes by drawing lines of symmetry. [PS, V] | **General Outcome**<br>Describe motion in terms of a slide, a turn or a flip.<br>**Specific Outcomes**<br>20. Recognize motion as a slide (translation), turn (rotation) or a flip (reflection). [T, V]<br>21. Recognize tessellations created with regular and irregular shapes in the environment. [CN, V]<br>22. Cover a surface, using one or more tessellating shapes. [PS, T, V]<br>23. Create tessellations, using regular polygons. [PS, T]<br>24. Identify planes of symmetry by cutting solids. [PS, V] |
| | **General Outcome**<br>Use coordinates to describe the positions of objects in two dimensions.<br>**Specific Outcomes**<br>25. Plot whole number ordered pairs in the first quadrant with intervals of 1, 2, 5, 10. [C]<br>26. Identify a point in the first quadrant, using ordered pairs. [C] |


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Strand: Shape and Space (Transformations)

*Students will:*

- perform, analyze and create transformations.

| | | | |
|---|---|---|---|
| C | Communication | PS | Problem Solving |
| CN | Connections | R | Reasoning |
| E | Estimation and Mental Mathematics | T | Technology |
| | | V | Visualization |

| Grade 6 | Grade 7 |
|---|---|
| **General Outcome**<br>Create patterns and designs that incorporate symmetry, tessellations, translations and reflections. | **General Outcome**<br>Create and analyze patterns and designs, using congruence, symmetry, translation, rotation and reflection. |
| **Specific Outcomes**<br>19. Create, analyze and describe designs, using translations (slides) and reflections (flips). [C, T, V]<br>20. Draw designs, using ordered pairs, in the first quadrant of the coordinate grid. [PS, V] | **Specific Outcomes**<br>11. Create, analyze and describe designs, using translations (slides), rotations (turns) and reflections (flips). [C, T, V]<br>12. Use informal concepts of congruence to describe images after translations, rotations and reflections. [C, T]<br>13. Draw designs, using ordered pairs, in all four quadrants of the coordinate grid, together with translation and reflection images. [PS, V]<br>14. Relate reflections to lines and planes of symmetry. [CN, V] |


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Strand: Statistics and Probability (Data Analysis)

*Students will:*

- collect, display and analyze data to make predictions about a population.

| | | | |
|---|---|---|---|
| **C** | Communication | **PS** | Problem Solving |
| **CN** | Connections | **R** | Reasoning |
| **E** | Estimation and Mental Mathematics | **T** | Technology |
| | | **V** | Visualization |

| Kindergarten | Grade 1 |
|---|---|
| **General Outcome**<br>Collect and organize, with assistance, data based on first-hand information. | **General Outcome**<br>Collect, organize and describe, with guidance, data based on first-hand information. |
| **Specific Outcomes**<br>1. Collect, with assistance, first-hand information. [C, PS]<br>2. Construct, with assistance, a concrete/object graph, using one-to-one correspondence. [PS, V]<br>3. Compare data in two categories, using such words as more, less, the same. [C, CN] | **Specific Outcomes**<br>1. Collect, with guidance, first-hand information by counting objects, conducting surveys, measuring and performing simple experiments. [C, PS]<br>2. Construct, with guidance, a concrete/object graph and a pictograph, using one-to-one correspondence. [CN, PS, V]<br>3. Compare data, using appropriate language, including quantitative terms, such as how many more. [C, E]<br>4. Pose oral questions in relation to the data gathered. [C, PS] |


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Strand: Statistics and Probability (Data Analysis)

*Students will:*

- collect, display and analyze data to make predictions about a population.

| | | | |
|---|---|---|---|
| C | Communication | PS | Problem Solving |
| CN | Connections | R | Reasoning |
| E | Estimation and Mental Mathematics | T | Technology |
| | | V | Visualization |

| Grade 2 | Grade 3 |
|---|---|
| **General Outcome**<br><br>Collect, display and describe data, independently, based on first-hand information.<br><br>**Specific Outcomes**<br><br>1. Formulate the questions and categories for data collection, and actively collect first-hand information. [C, PS, R]<br>2. Choose an appropriate recording method, such as tally marks, to collect data. [R]<br>3. Organize data, using such graphic organizers as diagrams, charts and lists. [CN, PS]<br>4. Construct and label concrete/object graphs, pictographs and bar graphs. [PS, V]<br>5. Discuss data, and draw and communicate appropriate conclusions. [C, R]<br>6. Generate new questions from displayed data. [C, R] | **General Outcome**<br><br>Collect first- and second-hand data, display the results in more than one way, and interpret the data to make predictions.<br><br>**Specific Outcomes**<br><br>1. Collect data, using measuring devices and printed/technology resources. [PS, T]<br>2. Display data, using rank ordering. [C, V]<br>3. Display the same data in more than one way. [PS]<br>4. Make predictions and inferences when solving similar problems. [CN, E, PS]<br>5. Obtain new information by performing arithmetic operations on the data. [E, PS, T] |


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Strand: Statistics and Probability (Data Analysis)

*Students will:*

- collect, display and analyze data to make predictions about a population.

| | | | |
|---|---|---|---|
| C | Communication | PS | Problem Solving |
| CN | Connections | R | Reasoning |
| E | Estimation and Mental Mathematics | T | Technology |
| | | V | Visualization |

| Grade 4 | Grade 5 |
|---|---|
| **General Outcome**<br>Collect first- and second-hand data, assess and validate the collection process, and graph the data. | **General Outcome**<br>Develop and implement a plan for the collection, display and interpretation of data to answer a question. |
| **Specific Outcomes**<br>1. Select a sample or population, and organize the collection of data. [PS]<br>2. Manipulate data to create an interval graph/table for display purposes. [PS, V]<br>3. Construct a bar graph and a pictograph, using many-to-one correspondence, and justify the choice of intervals and correspondence used. [C, T, V]<br>4. Discuss the process by which the data was collected. [C, R] | **Specific Outcomes**<br>1. Identify a question to generate appropriate data, and predict results. [C, R]<br>2. Distinguish between a total population and a sample of that population. [R]<br>3. Use a variety of methods to collect and record data. [PS, T]<br>4. Evaluate the graphic presentation of the data to ensure clear representation of the results. [C, R]<br>5. Create classifications and ranges for grouping data. [PS, R]<br>6. Display data by hand or by computer in a variety of ways, including:<br>• frequency diagrams<br>• line plots<br>• broken-line graphs.<br>[C, T, V]<br>7. Discuss the reasonableness of data and results. [C, R]<br>8. Make inferences to generate a conclusion about the data. [E, PS] |


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Strand: Statistics and Probability (Data Analysis)

*Students will:*

- collect, display and analyze data to make predictions about a population.

| | | | |
|---|---|---|---|
| C | Communication | PS | Problem Solving |
| CN | Connections | R | Reasoning |
| E | Estimation and Mental Mathematics | T | Technology |
| | | V | Visualization |

| Grade 6 | Grade 7 |
|---|---|
| **General Outcome**<br>Develop and implement a plan for the collection, display and analysis of data gathered from appropriate samples. | **General Outcome**<br>Develop and implement a plan for the collection, display and analysis of data, using measures of variability and central tendency. |
| **Specific Outcomes**<br>1. Formulate questions for investigation, given a context. [C, CN, R]<br>2. Identify appropriate data sources: first-hand, second-hand and combination. [R]<br>3. Select and use appropriate methods of collecting data:<br>• designing and using structured questionnaires<br>• experiments<br>• observations<br>• electronic networks.<br>[C, PS, T]<br>4. Select and defend the choice of an appropriate sample or population to be used to answer a question. [C, R]<br>5. Discuss how collected data are affected by the nature of the sample, the method of collection, the sample size and biases. [C, CN]<br>6. Display data by hand or by computer in a variety of ways, including:<br>• histograms<br>• double bar graphs<br>• stem and leaf plots.<br>[C, T, V]<br>7. Read and interpret graphs that are provided. [C, E, PS, R]<br>8. Describe the general distribution of data, using:<br>• smallest and largest value<br>• frequency<br>• value in the middle<br>• patterns.<br>[C, CN]<br>9. Analyze sets of data to make comparisons. [E, PS, R] | **Specific Outcomes**<br>1. Formulate questions for investigation, from a real-world context. [C, CN, R]<br>2. Select, defend and use appropriate methods of collecting data:<br>• designing and using questionnaires<br>• interviews<br>• experiments<br>• research.<br>[C, PS, T]<br>3. Describe issues to be considered when collecting data; e.g., appropriate language, ethics, cost, privacy, cultural sensitivity. [C, CN, R]<br>4. Display data by hand or by computer in a variety of ways, including circle graphs. [C, T, V]<br>5. Read and interpret graphs. [C, E, PS, R]<br>6. Determine measures of central tendency for a set of data:<br>• mode<br>• median<br>• mean.<br>[PS]<br>7. Determine measures of the distribution of a set of data:<br>• range<br>• extremes, gaps and clusters<br>• quartiles.<br>[PS]<br>8. Interpolate from data to make predictions. [E, PS, R] |


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Strand: Statistics and Probability (Chance and Uncertainty)

*Students will:*

- use experimental or theoretical probability to represent and solve problems involving uncertainty.

| | | | |
|---|---|---|---|
| C | Communication | PS | Problem Solving |
| CN | Connections | R | Reasoning |
| E | Estimation and Mental Mathematics | T | Technology |
| | | V | Visualization |

| Kindergarten | Grade 1 |
|---|---|
| [no outcomes at this grade level] | **General Outcome**<br>Describe concepts of chance and chance events, using ordinary vocabulary.<br>**Specific Outcomes**<br>5. Predict the chance of an event happening, using the terms never, sometimes, always. [C, R] |


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Strand: Statistics and Probability (Chance and Uncertainty)

*Students will:*

- use experimental or theoretical probability to represent and solve problems involving uncertainty.

| | | | |
|---|---|---|---|
| C | Communication | PS | Problem Solving |
| CN | Connections | R | Reasoning |
| E | Estimation and Mental Mathematics | T | Technology |
| | | V | Visualization |

| Grade 2 | Grade 3 |
|---|---|
| **General Outcome**<br>Use simple experiments, designed by others, to illustrate chance.<br>**Specific Outcomes**<br>7. Describe the likelihood of an outcome, using such terms as likely, unlikely, expect, probably. [C, R]<br>8. Make a prediction based on a simple probability experiment. [E, PS] | **General Outcome**<br>Use simple probability experiments, designed by others, to explain outcomes.<br>**Specific Outcomes**<br>6. Describe the likelihood of an outcome, using such terms as more likely, less likely, chance. [C, R]<br>7. Conduct a probability experiment, choose an appropriate recording method, and draw conclusions from the results. [C, E, PS] |


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Strand: Statistics and Probability (Chance and Uncertainty)

*Students will:*

- use experimental or theoretical probability to represent and solve problems involving uncertainty.

| | | | |
|---|---|---|---|
| **C** | Communication | **PS** | Problem Solving |
| **CN** | Connections | **R** | Reasoning |
| **E** | Estimation and Mental Mathematics | **T** | Technology |
| | | **V** | Visualization |

| Grade 4 | Grade 5 |
|---|---|
| **General Outcome**<br><br>Design and use simple probability experiments to explain outcomes.<br><br>**Specific Outcomes**<br><br>5. Identify an outcome as possible, impossible, certain, uncertain. [C, R]<br>6. Compare outcomes as equally likely, more likely, less likely. [C, R]<br>7. Design and conduct experiments to answer one's own questions. [C, E, PS] | **General Outcome**<br><br>Predict outcomes, conduct experiments and communicate the probability of single events.<br><br>**Specific Outcomes**<br><br>9. List all possible outcomes of an experiment involving a single event. [PS]<br>10. Describe events, using the vocabulary of probability:<br>• best/worst<br>• probable/improbable<br>• always/more likely/equally likely/less likely/never.<br>[C, R]<br>11. Conduct probability experiments, and explain the results, using the vocabulary of probability. [C, E, PS]<br>12. Conduct probability experiments to demonstrate that results are not influenced by such factors as the age, experiences or skills of the participant. [R, T] |


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Strand: Statistics and Probability (Chance and Uncertainty)

*Students will:*

- use experimental or theoretical probability to represent and solve problems involving uncertainty.

| | | | |
|---|---|---|---|
| C | Communication | PS | Problem Solving |
| CN | Connections | R | Reasoning |
| E | Estimation and Mental Mathematics | T | Technology |
| | | V | Visualization |

| Grade 6 | Grade 7 |
|---|---|
| **General Outcome**<br>Use numbers to communicate the probability of single events from experiments and models. | **General Outcome**<br>Create and solve problems, using probability. |
| **Specific Outcomes**<br>10. Distinguish between experimental and theoretical probability for single events. [PS, R]<br>11. Make the connection between the number of faces, for various dice, and the probability of a single event. [CN, R]<br>12. Calculate theoretical probability, using numbers between 0 and 1. [E, PS]<br>13. Demonstrate that different outcomes may occur when repeating the same experiment. [PS, T]<br>14. Compare experimental results with theoretical results. [C, E, R] | **Specific Outcomes**<br>9. Use a table to identify all possible outcomes of two independent events. [PS, R]<br>10. Create and solve problems, using the numerical definition of probability as favourable outcomes divided by possible outcomes. [PS, R]<br>11. Use the Monte Carlo simulation method to solve probability problems. [CN, E, PS, T] |


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